DRAFT

THE CENTRAL CALIFORNIA OZONE STUDY (CCOS)

SCOPE OF WORK

(SIP Plan)

January 19, 1999

I. INTRODUCTION

A. Summary

This document describes a field data collection program to support ozone modeling for much of central California.

In 2003, California will be required to submit SIPs to the U.S. Environmental Protection Agency (U.S. EPA) for the recently promulgated, national, 8-hour ozone standard. It is expected that such SIPs will be required for the San Francisco Bay Area, the Sacramento Valley, the San Joaquin Valley, and the Mountain Counties Air Basins. Photochemical air quality modeling will be necessary to prepare SIPs that are acceptable to the U.S. EPA.

While an episode that was simulated using data acquired in 1990 by the San Joaquin Valley Air Quality Study will be usable for the 2003 SIP work for the San Joaquin Valley, our ability to address the new ozone standard will be substantially enhanced if we are able to develop additional, more contemporary simulations designed more specifically around the 8-hour standard. We have a unique opportunity to acquire the field data for additional modeling for this area assuming that we can leverage an approximately $10 million, fine particulate matter field study to be conducted in the same area during 2000. If we can augment the data to be collected during the summer of 2000 by the particulate matter study, we will be able to improve our confidence in the control strategies we incorporate in the SIPs with substantially less money than if we were to conduct the proposed work independently.

Data collected under this proposal will be used to simulate one or more ozone episodes that will be used by the ARB and the districts to evaluate candidate SIP control strategies and to do demonstrations of attainment that must be included in SIPs. These simulations will also be used by the ARB and the districts to assess inter-basin transport, to estimate impacts large emission sources would have on regional ozone levels, and to evaluate the air quality consequences of changes in land use, transportation, and industry. Such changes might include

construction of large power plants, and oil and gas production facilities or major transportation system changes.

This proposal includes a range of data collection activities. The minimum program that would help with the 2003 SIP for only the San Francisco Bay Area Air Basin and the Sacramento area, including providing an ability to assess the transport into and from adjacent air basins, would cost approximately $2.25 million (M). This Level-1 study would cover the smallest study domain shown in Figure 1.

A larger study could be conducted for the Bay Area and the entire Central Valley, but the kinds and amounts of data collected would be the minimum needed for modeling, for a cost of $5.05M. This is described later as a Level-2 program (see Figure 2).

A comprehensive measurement program throughout all of central California--from Redding in the North to the Mojave Desert in the South, and from Pacific Ocean in the West to the Sierra Nevada Mountains in the East (see Figure 3)--would provide a database for modeling with minimum uncertainty. This program, which is described later as a Level-3 program, would cost approximately $10M. Without the Level-3 enhancements less data would be available for transport and boundary conditions.

B. Technical Objectives

The primary objective of this study is to obtain a suitable database for grid-based, photochemical modeling. The ARB and districts will use this database to apply photochemical models to examine the effects of emission reductions on ozone concentrations and to prepare the demonstrations of attainment for the 8-hour ozone standard for non-attainment areas in central California.

The CCOS will be designed to collect data continuously during the summer of 2000. Specifically, surface and upper air meteorological data as well as surface air quality data for NO_x

and ozone will be continuously collected during the entire summer of 2000. This database will be suitable for modeling. In order to better understand the physics and chemistry of the formation of high ozone concentrations and to reduce uncertainty in the models used for SIP, additional data will be collected during ozone episodes. Surface air quality data for hydrocarbons, air quality data aloft measured from aircraft, and data measured using special instruments such as Lidar will be collected during 20 high ozone days.

C. Background

In order to explain each level of effort and its associated cost and benefit, it is appropriate to start with the description of airflow fields and the associated ozone episodes in the region.

During a typical summer day, airflow over the Pacific Ocean is from the northwest. Over the coast of central California, flow becomes westerly and penetrates the Central Valley through various gaps along the coastal ranges. The largest gap in the coastal ranges is located in the San Francisco Bay Area. Airflow reaching the Central Valley through the Carquinez Strait is directed northward into the Sacramento Valley, southward into the San Joaquin Valley (SJV), and eastward into the Mountain Counties. The amount of air entering into these regions depends on the location and strength of the Eastern Pacific High Pressure System (EPHPS). The EPHPS rotates in the clockwise direction and moves from the west to east. If the EPHPS is approaching the coast of California, it will increase the amount of air entering the SJV. If it has passed over California, it will increase the amount of air entering the Sacramento Valley. When the center of the EPHPS is over central California, the amount of air entering the Central Valley will be limited. If the southern end of the EPHPS is over the Delta region, the amount of air entering the Central Valley will be blocked, occasionally reversing its direction.

This complex feature of airflow, unique to a region from the Pacific Ocean to the Sierra Nevada Mountains, and from Yuba City to Modesto, contributes to various types of ozone episodes in the SJV, Sacramento Valley, Mountain Counties and the Bay Area. Both local and transport ozone episodes are observed in the SJV as well as the Sacramento area depending upon

the nature of airflow in the region. In the Bay Area, ozone concentrations are elevated when airflow from the Bay Area to the Central Valley is limited. Elevated ozone concentrations are observed in the Mountain Counties due mostly to transported pollutants. Transport of pollutants from the northern SJV to the central and southern SJV is accelerated at night due to the "low-level jet" (an airflow that develops at night and moves from the north to south along the SJV with a speed of 10-15 m/sec). Air also rotates in the counterclockwise direction around Fresno (Fresno Eddy) in the morning hours, limiting the ventilation of air out of the SJV. During the day, pollutants are transported from the SJV to the Mojave Desert via the Tehachapi Pass. Occasionally an outflow from the SJV to the San Luis Obispo area is observed.

Utilizing the knowledge about the characteristics of airflow, emissions and air quality of the region as well as the knowledge gained from the 1990 San Joaquin Valley Air Quality Study and its subsequent data analysis and modeling work, we have designed a preliminary field study for the year 2000. In this study, we have identified two levels of effort and an optional measurement program. The Level-1 and Level-2 efforts will mainly focus on the collection of data for grid based air quality model applications. The Level-1 effort geographically will cover an area from the Pacific Ocean to Sierra Nevada Mountains and from Yuba City to Modesto. The Level-2 effort will cover the outlined area of the Level-1 effort as well as the remainder of SJV. Thus, the Level-2 effort will cover an area from the Pacific Ocean to the Sierra Nevada Mountains and from Yuba City to the Tehachapi Mountains. The optional measurements will be an addition to the Level-1 and Level-2 efforts and will have several components. First, they will extend the study domain further to the south into the Mojave Desert, and further to the north into the Upper Sacramento Valley. This larger domain could provide a database to study regional flow circulations and pollutant transport. Second, the optional measurements will provide additional data for better understanding of atmospheric processes. Finally, they will provide data for specification of boundary conditions of the model.

II. PROJECT DESCRIPTION

As mentioned earlier, three levels of effort are being proposed depending on the availability of funding. In this section, we describe these efforts. The Level-1 and Level-2 efforts are designed to obtain a minimum database for grid-based modeling. The Level-3 effort is designed to enhance the Level-1 and Level-2 efforts to better understand the causes leading to the violation of the 8-hour ozone standard and to reduce the uncertainty in the SIP model. The Level-1 and Level-2 efforts are similar, except for the size of the field monitoring program. The Level-1 monitoring domain as shown in Figure 1 is limited to the Bay Area, Lower Sacramento Valley and northern portion of the SJV. The Level-2 monitoring domain as shown in Figure 2, will cover the Level-1 area and the central and southern parts of the SJV. Details of the levels of effort are given below:

A. Description of Level-1 effort

The Level-1 effort consists of a field monitoring study for the region extending from the Pacific Ocean to the Sierra Nevada Mountains and from Yuba City to the City of Modesto (Figure 1). The objective of the field monitoring study is to gather a 3-dimensional database for meteorology and air quality. The database obtained from this study will be used for modeling to prepare the 8-hour SIP for ozone and to conduct data analysis to better understand the transport mechanism and the source/receptor relationships between the Bay Area and lower portion of the Sacramento Valley (Sacramento Area) as well as the northern portion of the SJV. The simulations will be conducted for various types of transport and local ozone episodes within each air basin.

To meet the goals of the Level-1 effort, the field monitoring plan relies upon continuous monitoring at the surface and aloft as well as intensive measurements made during forecasted ozone episodes. Table 1 shows the types of measurements proposed during the field program.

Table 1

– 8 profilers/sodars (continuous measurements)
– 8 new surface meteorological stations (continuous measurements)

- 10 new surface air quality stations (continuous measurements for ozone and NOx and speciated hydrocarbon measurements for 20 high ozone days)
- Aircraft measurements for 20 high ozone days
- 5 ozone sonde stations which will operate for 20 high ozone days
- 2 NOx sonde stations which will operate for 20 high ozone days

The cost estimates of the Level-1 effort is discussed in Table 4.

B. Description of Level-2 effort

The Level-2 effort would provide a database throughout all of the Central Valley and the San Francisco Bay Area (see Figure 2). Similar to the Level-1 effort, the Level-2 effort is also limited to obtain a minimum database for grid-based photochemical modeling. However, several analysis projects suggested by WSPA are included in the Level-2 effort. Because of the larger size of the domain, the Level-2 effort could better address regional pollutant transport. Like the Level-1 effort, the Level-2 effort will also have both continuous and episodic measurement components.

The types of measurements for Level-2 are shown in Table 2.

Table 2

- 15 profilers/sodars (continuous measurements)
- 15 new surface meteorological stations (continuous measurements)
- 27 new surface air quality stations (continuous measurements for ozone and NOx and speciated hydrocarbon measurements for 20 high ozone days)
- 2 aircraft measurements for 20 high ozone days (one aircraft will cover the Bay Area, Sacramento, and northern SJV, the other will cover central and southern SJV)
- 10 ozone sonde stations which will operate for 20 high ozone days
- 4 NOx sonde stations which will operate for 20 high ozone days

The cost estimates of the Level-2 effort is discussed in Table 5.

C. Description of Level-3 effort

To further enhance our understanding of the mechanistic processes leading to high ozone concentrations in central California, we have identified measurements that could be added to the Level-1 or Level-2 effort should funding become available. With the Level-3 measurements, the study domain could be extended further to the south and west, respectively, for the Mojave Desert, and the Pacific Ocean. In addition, a more dense network of measurements at the surface and aloft could be achieved. The larger domain would enhance our understanding of the role of transport between the air basins within central California as well as minimize the effects of specifying boundary conditions for model inputs. Finally, the Level-3 measurements would provide a database to more rigorously test and evaluate the meteorology and air quality modeling system.

The types of measurements for the Level-3 effort are shown in Table 3.

Table 3

- Enhancements to meteorological measurements (Lidar measurements)
- Enhancements to air quality measurements (Lidar measurements)
- Western boundary condition Measurements
- Tracer study
- Micrometeorological measurements from a 100m tower
- Plume rise measurements
- Measurements for evaluation and improvements of emissions

The cost estimates of the Level-3 effort is discussed in Table 6.

III. MODELING

The ARB and districts will apply air quality models using the database obtained from the field study and prepare the 2003 SIP. Models used in the regulatory process need to be readily available to the public. Candidate models for meteorology, emissions, and air quality will be evaluated based upon their formulation and past performance evaluations. The best model(s) will be selected for use. The selected models will be further evaluated using the CCOS database based upon the model evaluation criteria developed by U.S. EPA and ARB. Some of the candidate models are listed below:

MM5

CALMET

RAMS

EMS95

SAQM

MODELS3

CAMX

MAQSIP

ARB will analyze the data collected during the 2000 field study and will select up to three ozone episodes to simulate with the selected models. ARB staff (in-kind resources) will conduct this work. Assistance will be sought from air districts to develop day-specific emission inventories as well as additional simulation days.

IV. EMISSION INVENTORY

Confidence in the results from modeling simulations for a SIP requires that a comprehensive temporally and spatially resolved gridded emissions inventory, as well as meteorology and air quality be available for modeling inputs. Many improvements to the emissions inventory on a state-wide bases and specifically in Central California have occurred since the adoption of the 1994 ozone SIP. These improvements have focused on acquiring better activity data, as well as the development of new emission factors for motor vehicles, point

sources, and biogenic emissions. The following lists some of the areas of improvements in the emissions inventory:

- Incorporation of new temporal profiles of activity data for motor vehicles and point sources
- Incorporation of new VOC speciation profiles of motor vehicles and some point sources
- Updating of motor vehicle emissions model (EMFAC99)
- Incorporation of NOx emissions from agricultural I.C. engine and VOC emissions from animal waste in the SJV
- Development of new biogenic emission factors and biomass estimates.

Improvements in the emissions inventory for Level-1 and Level-2 rely entirely on the work being conducted by ARB either though in-house resources or contract work. However, further improvements in the emissions inventory have been identified in the Level-3 effort of this workplan. They include source sampling for large point sources, speciation profiles of biogenic sources, day-specific activity information for motor vehicle counts, and quantification of wildfire emissions.

V. COST

A conceptual design of the CCOS field monitoring program was developed based upon what has been learned from 1) the 1990 field monitoring program for the San Joaquin Valley Air Quality Study (SJVAQS), 2) data analyses and modeling studies conducted by ARB staff and consultants, and 3) the preliminary design of the field monitoring program for the California Regional Particulate Air Quality Study (CRPAQS). The cost of the CCOS field program was estimated for three levels of effort.

Knowledge gained from the SJVAQS, CRPAQS and the SARMAP data analysis and modeling work allowed for the design of a field program minimizing redundant measurements. This effort allows for a reduction in the number of measurement stations for CCOS when compared to previous studies, resulting in substantial cost savings. Details of the cost estimates for the three levels of effort are shown in Tables 4 through 6, respectively.

In summary, the Level-1 effort is estimated to cost $2.25M. The Level-2 effort, which encompasses the Level-1 effort, would cost an additional $2.8M for a total of $5.05M. The ARB is committed to fund the Level-1 effort. The ARB requests that the California Energy Commission fund the difference between the Level-1 and Level-2 efforts to complete the Level-2 effort.

The Level-3 effort, which is additional measurements to the Level-1 and Level-2 efforts, would cost $4.5M. The ARB will seek funds for the difference between the Level-2 and Level-3 efforts from other organizations. A comprehensive measurement program that included all three levels of effort would cost $9.55M.

Potential Study Sponsors:

The potential sponsors of the study for the various levels of effort are:

California Air Resources Board ($2.25M committed)
U.S. EPA
California Energy Commission ($2.8M requested)
Local Air Pollution Control Districts (SAQMD, BAAQMD, SJVUAPCD, MBUAPCD, Yolo-Solano APCD, Mountain Counties)
Industry

VI. SCHEDULE

Activity	Completion Date
Planning	
Preparation of workplan	1/31/1999
Final field program design	7/1/1999
Issue RFPs	7/10/1999
Contractors selection	9/15/1999
Executable Contracts	2/1/2000
Field Monitoring Study	
Field study begins	6/1/2000
Field study ends	9/30/2000
Database Management/QA/QC	
QA/QC of data	12/31/2000
Data archive	4/31/2001
Data Analysis/Emissions/Modeling	
Data analysis	12/31/2001
Emission inventory development	9/31/2001
Model improvements	9/31/2001
Base-case simulations (model performance, diagnostic/sensitivity testing)	3/31/2002
Future year emission inventory and sensitivity simulations	9/30/2002

VII. MANAGEMENT STRUCTURE

The overall management of CCOS will be under the general direction of the Division Chief of the Planning and Technical Support Division of the ARB. A Technical Committee (TC) will be established consisting of representatives from sponsors of CCOS. The committee will include ARB staff, staff from other governmental agencies as well as industry. The TC will assist ARB in the technical management of the study. The day-to-day project management role will be assumed by an ARB team consisting of the following staff members:

Program Manager:	Don McNerny, Chief, Modeling and Meteorology Branch
Technical Committee Chairman:	Andrew Ranzieri, Manager, Modeling Support Section
Principal Investigator:	Dr. Saffet Tanrikulu, Staff Air Pollution Specialist

Table 4

COST ESTIMATE FOR LEVEL-1 EFFORT

Meteorological measurements:

Upper-air meteorological measurements $400K

- CCOS will fund 8 profilers and 8 sodars (some of the profilers and sodars will be co-located). Possible sites are: Point Reyes, San Jose, Livermore, Altamont Pass, Brentwood, Stockton, Modesto, Angels Camp, Auburn, Yuba City, and Sacramento.
- Existing stations are located an operated respectively at Oakland by the NWS, Monterey by the NPGS, Fairfield by U.S. Air Force at Travis, and Sacramento by the SAQMD.
- CRPAQS-funded stations: Profilers and sodars located at Richmond and Crows Landing.

Surface meteorological measurements: $100K

- CCOS will fund 8 new surface meteorological stations. These stations will make measurements from either a 5m or 10m tower. In addition, CCOS will fund the calibration of some of the existing surface stations at key locations.
- Existing stations: There are about 60 existing stations operated by the ARB, air districts and CIMIS in the outlined area. Most of them make measurements at about 2m above the ground.
- CRPAQS-funded stations: two 10m towers, located at Bethel Island and at Altamont.

Air quality measurements:

Surface air quality measurements: $500K

- CCOS will fund air quality measurements at 10 new locations. Possible locations are: Richmond, Livermore, San Jose, Brentwood, Stockton, Modesto, Sacramento, Auburn, (one location in the Mountain Counties). CCOS will fund measurements for speciated HC and Carbonyls as well as Nitric acid and PAN (2-3 sites). Ozone and NOx measurements will be made continuously. Speciated HC and carbonyl measurements will be made for 20 ozone episode days.
- Existing stations: There are about 25 existing stations operated by ARB and air districts in the area, most of the stations measuring ozone and NOx.
- CRPAQS-funded stations: 2 stations located in Sacramento and San Jose.

Upper-air quality measurements:

Aircraft measurements: $350K

- CCOS will fund air quality measurements from one aircraft covering the Bay Area, Sacramento and northern San Joaquin Valley. It is anticipated that 2-3 flights a day will be made during 20 ozone episode days.
- Existing measurements: none
- CRPAQS funded measurements: none

Ozone sonde:

$100K

- CCOS will fund upper air ozone measurements at 5 locations, with releases made twice a day during 20 ozone episode days.
- Existing measurements: none
- CRPAQS funded measurements: none
- NOx sonde:

$100K

- CCOS will fund upper air NOx measurements at 2 locations, with releases made twice a day during 20 ozone episode days.

- Existing measurements: none
- CRPAQS funded measurements: none

Laboratory analysis of HC and Carbonyl measurements	$400K

Management

QA/QC manager	$100K
Field program manager	$100K
Siting/site renting	$100K

TOTAL:	**$2,250K**

Table 5

COST ESTIMATE FOR LEVEL-2 EFFORT

Data analysis and modeling for the field study design

The projects for data analysis and modeling were recommended by WSPA.

- Analysis of trends and characterization of variability $70K
- Analysis and evaluation of past SIP modeling in the SJV (in-kind resources)
- Appraisal of past findings and updating the conceptual model $30K

Meteorological measurements:

Upper-air meteorological measurements $850K

- CCOS will fund 15 profilers and 15 sodars (some of the profilers and sodars will be co-located). Possible sites are located at: Point Reyes, San Jose, Livermore, Altamont Pass, Brentwood, Stockton, Modesto, Angels Camp, Auburn, Yuba City, Redding, Sacramento, Fresno, Bakersfield, San Luis Obispo, and other areas of the San Joaquin Valley.
- Existing stations are located and operated respectively at Oakland by the NWS, Monterey by the NPGS, Fairfield by the U.S. Air Force at Travis, Sacramento by the SAQMD, Vandenberg by the U.S. Air Force, and Visalia by the SJVUAPCD.
- CRPAQS-funded stations are located at Richmond, Crows Landing, El Nido, Angiola, HUR, MRK, MCK, EDI, RSA.

Surface meteorological measurements: $200K

- CCOS will fund 15 new surface meteorological stations. Measurements will be made from either a 5m or 10m tower. In addition, CCOS will fund the calibration of some of the existing surface stations at key locations.

- Existing stations: There are about 80 existing stations operated by the ARB, air districts and CIMIS in the outlined area. Most of them make measurements at about 2m - 10m above the ground.
- CRPAQS-funded stations: Seven 10m towers and one 100m tower are located in the outlined area.

Air quality measurements:

Surface air quality measurements: $1300K

- CCOS will fund air quality measurements at 27 new locations. Possible locations are: Richmond, Livermore, San Jose, Brentwood, Stockton, Modesto, Sacramento, Auburn, Redding (five new locations in the Mountain Counties and 12 new locations in the SJV). CCOS will fund measurements for speciated HC and Carbonyls as well as Nitric acid and PAN (2-3 sites in the SJV). Ozone and NOx measurements will be made continuously. Speciated HC and carbonyl measurements will be made for 20 ozone episode days.
- Existing stations: There are about 40 existing stations in the area operated by the ARB and air districts, with most of the stations measuring ozone and NOx.
- CRPAQS-funded stations: 5 stations are to be located in Sacramento, San Jose, Fresno, Angiola, and Bakersfield.

Upper-air quality measurements:

Aircraft measurements: $700K

- CCOS will fund air quality measurements from two aircraft, one aircraft will cover the Bay Area, Sacramento and northern San Joaquin Valley, the other will cover the central and southern portions of the San Joaquin Valley. 2-3 flights will be made a day during 20 ozone episode days.
- Existing measurements: none

- CRPAQS funded measurements: none

Ozone sonde: $200K

- CCOS will fund ozone measurements at 10 locations, with releases made twice a day during 20 ozone episode days.
- Existing measurements: none
- CRPAQS funded measurements: none

NOx sonde: $200K

- CCOS will fund NOx measurements at 4 locations, with releases made twice a day during 20 ozone episode days.
- Existing measurements: none
- CRPAQS funded measurements: none

Laboratory analysis of HC and Carbonyl measurements $800K

Management

QA/QC manager	$200K
Field program manager	$200K
Siting/site renting	$300K
TOTAL:	**$5,050K***

***Includes Level-1 effort

Table 6

COST ESTIMATE FOR LEVEL-3 EFFORT

The Level-3 effort has a number of elements that could extend the study area to the Mojave Desert and Pacific Ocean, obtain a better database for model improvements and reducing model uncertainty. The following measurements would be possible with the Level-3 effort.

Areal Expansion

Mojave Desert

- Three upper air meteorological stations located in the Mojave Desert. $200K
- Three new surface air quality monitoring stations located in the desert, and enhancements to existing stations operated by air districts. $150K

Enhancements to Meteorological Measurements:

Upper-air meteorological measurements

- Lidar measurements: Lidar has the capability to capture detailed wind and temperature information. Two lidars are proposed, one will cover the San Joaquin Valley, the other will cover the Bay Area, Sacramento and the northern San Joaquin Valley. Lidars will operate during 20 intensive measurement days. $300K

Surface meteorological measurements:

- A 100m tower will be established in the northern SJV for micrometeorological measurements. CRPAQS will fund a 100m tower for micrometeorological measurements in the southern SJV

(Angiola site). Measurements obtained from both towers will be used to evaluate and improve the scientific understanding of the vertical mixing processes during early morning breakup of ground based inversions as well as to determine the surface deposition rates of pollutants. $350K

Enhancements to Air Quality Measurements:

Surface air quality measurements:

- DOAS measurements: DOAS is capable of measuring ozone, NO, NO2, NO3, HONO, and, HCHO over a spacial scale 500-1000 m. Three DOAS sites are proposed which are located in the Bay Area, northern SJV and southern SJV. DOAS will operate during 20 intensive measurement days. $400K

- Surface-based ozone lidar. Two lidar stations are proposed. One will be located in he Bay Area and the northern SJV, and the other located in the central SJV. $300K

Upper-air quality measurements:

- Aloft Lidar: Aircraft based lidar systems can measure ozone and track large elevated NOx plumes. One lidar-instrumented aircraft is proposed to monitor ozone aloft for 20 intensive measurement days. $300K

Tracer Experiments

In order to evaluate the performance of meteorological models for assessing the transport of pollutants, five tracer studies are proposed to be conducted under different meteorological conditions. Possible tracer release locations are: San Jose, Pittsburg, Sacramento, Modesto, and Fresno. Tracers will be released from ground level as well as from aloft layers. Tracers will be

monitored from surface stations as well as aircraft.

$350K

Boundary Measurements:

For air quality modeling, the correct specification of the western boundary conditions is important because the western boundary directly affect ozone concentrations in the portions of the modeling domain, especially in the San Francisco Bay Area and along the coastline. Aircraft measurements are proposed to be made along the western boundary of the modeling domain to specify western boundary conditions for ozone and precursor gases. Measurements will be made under for different meteorological conditions. $500K

Plume Rise Measurements:

To gain a better scientific understanding of transport, the fate of NOx, and mixing from elevated buoyant plumes, it is proposed to conduct aircraft measurement of ozone and NOx concentrations using lidar technology. Possible source candidates are powerplants, refineries and other large buoyant plumes. These measurements will be conducted for different meteorological conditions. $250K

Measurements for Evaluation and Improvements of Emissions:

- It is proposed, in consultation with ARB's Emission Inventory Branch, to conduct source sampling of the stationary sources to improve day-specific emission inventory. These measurements will be made during 20 intensive measurement days. $200K
- Conduct studies to collect profiles of speciated hydrocarbons for major emission sources for use in emission source reconciliation work. $200K
- Conduct a study to collect hydrocarbon measurements from various tree species and to obtain a database on leaf biomass to improve the biogenic emission inventory. $300K

- Conduct traffic counts, wildfire monitoring for improving day specific emission inventory $150K

Siting and Field Management:

Siting and rentals	$300K
Field program management	$150K
TOTAL for optional measurements	**$4,500K**

Figure 1. CCOS modeling domain. Level-1 field study area is outlined.

Figure 2. CCOS modeling domain. Level-2 field study area is outlined.

Figure 3. CCOS modeling domain. Level-3 study area is outlined.